

Lecture 8 : Biopotential Electrodes

0. Review

1. Basic electrochemistry

2. Electrode - Skin Interface

3. EMG

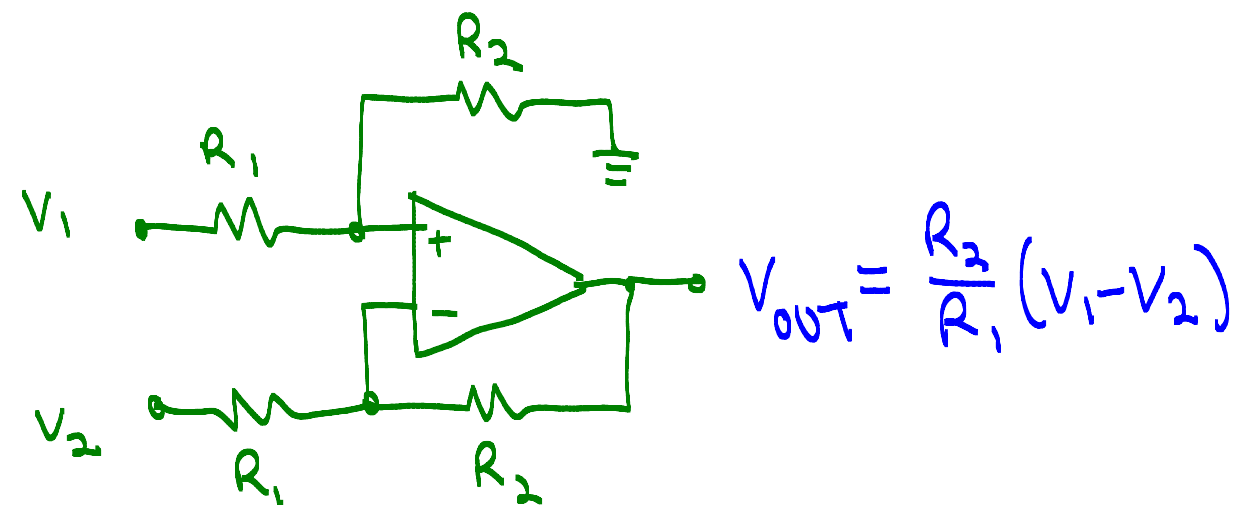
- Today : HW3
 - Next Tue : Quiz ← HW3 material
 - Fri : Lab 2 report
 - Lab 3 report due Feb 14
-

- Exam #1 (Feb 6) !
 - HW 1, 2, 3 material
 - Lectures 1-8
 - Course website will have sample exam + solutions

0. Review

- Single Op Amp Differential Amplifier

→ Mediocre input impedance



- Instrumentation Amplifier

① High input impedance

② High CMRR = $20 \log_{10} \left(\frac{A_d}{A_{CM}} \right) \equiv$ Common Mode Rejection Ratio

• Inst Amp Output: $V_{OUT} = V_{REF} + A_d \overbrace{(V_1 - V_2)}^{\Delta V} + A_{CM} \boxed{\frac{V_1 + V_2}{2}}$

"Common Mode" Gain
"Common Mode" Input

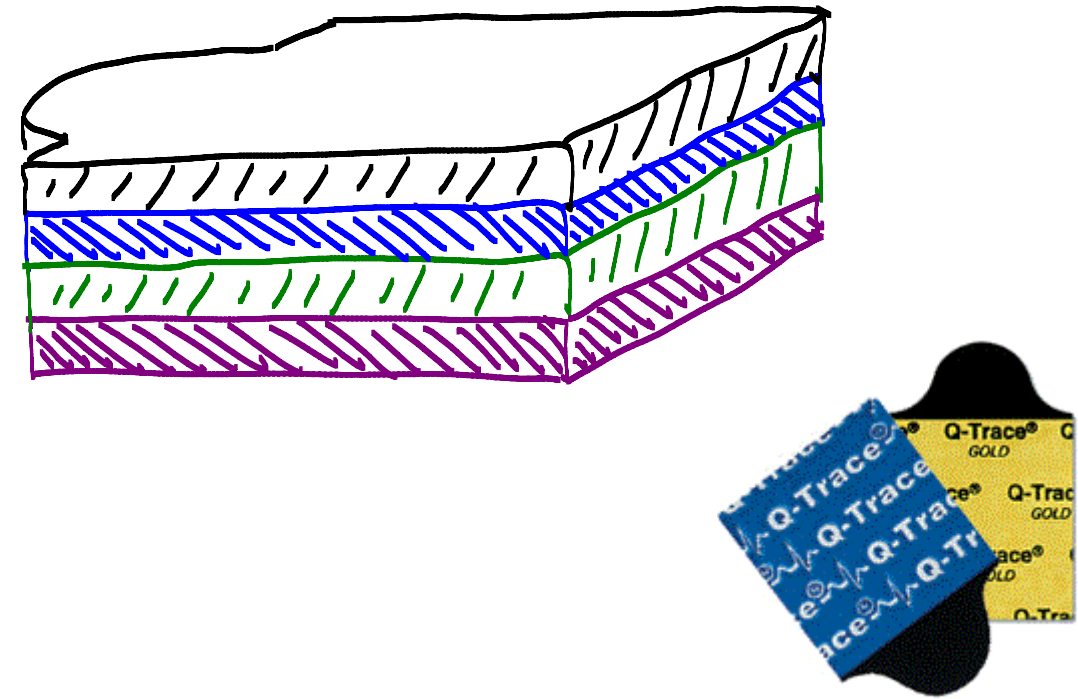
1. Basic Electrochemistry

- Electronic vs. Ionic Current

The most commonly used electrode material for measuring biopotentials is

Q: Why not use a thin piece of metal?

A: In order to measure voltage, the measuring device MUST draw some current from the object.

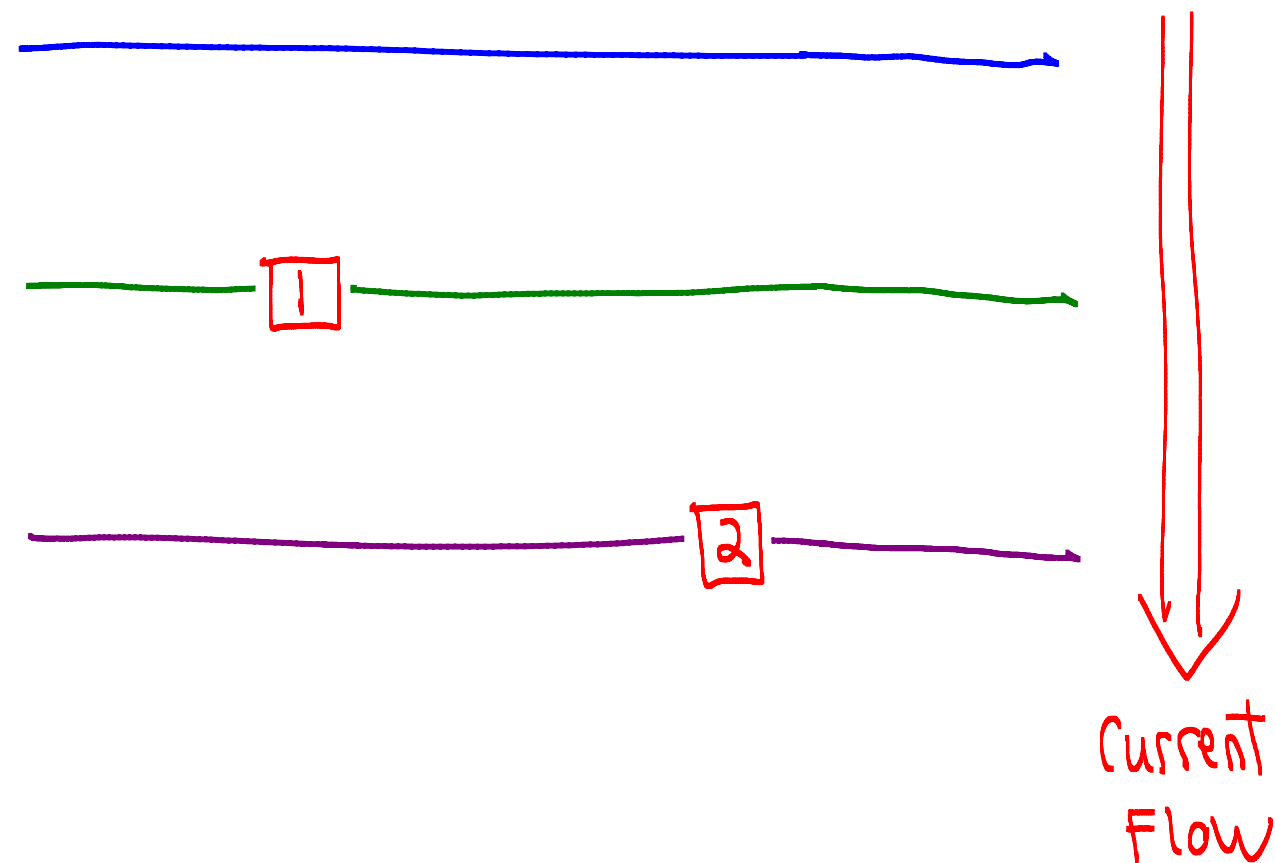


- Electrode - Electrolyte Interface

A. Current flow into body

1

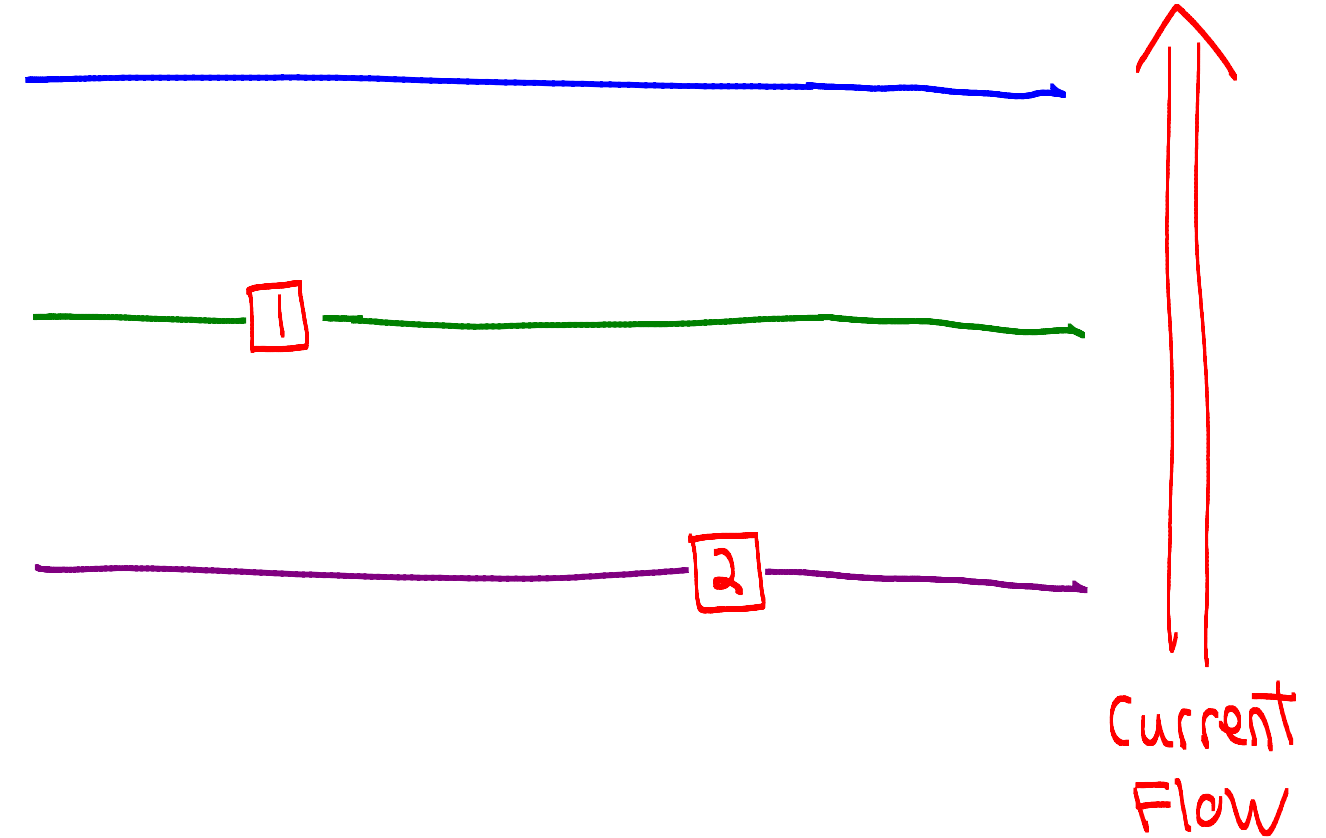
2



B. Current Flow Out of body

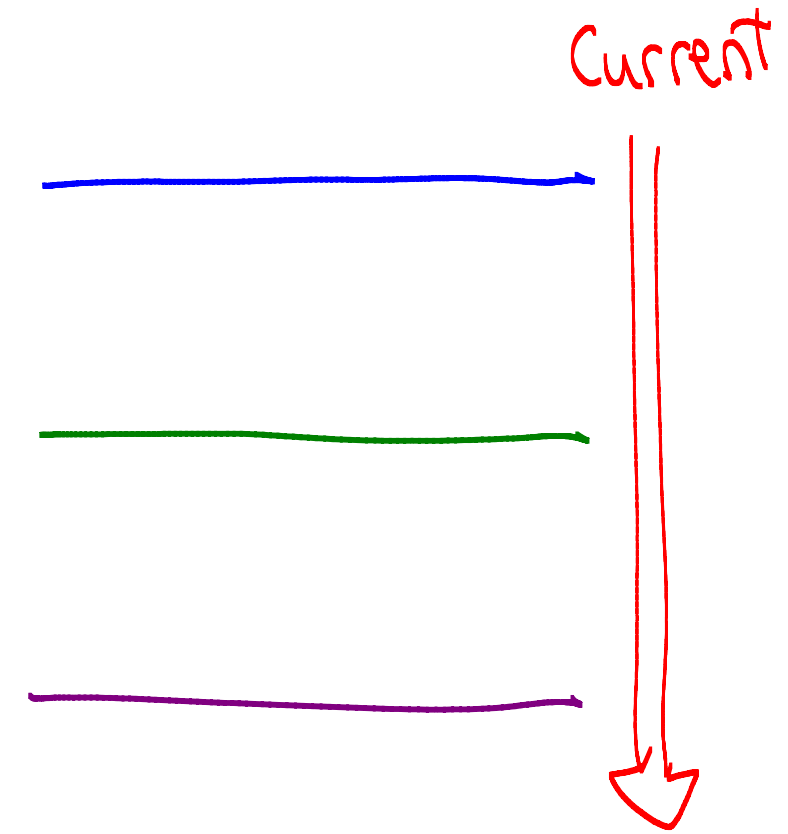
1

2

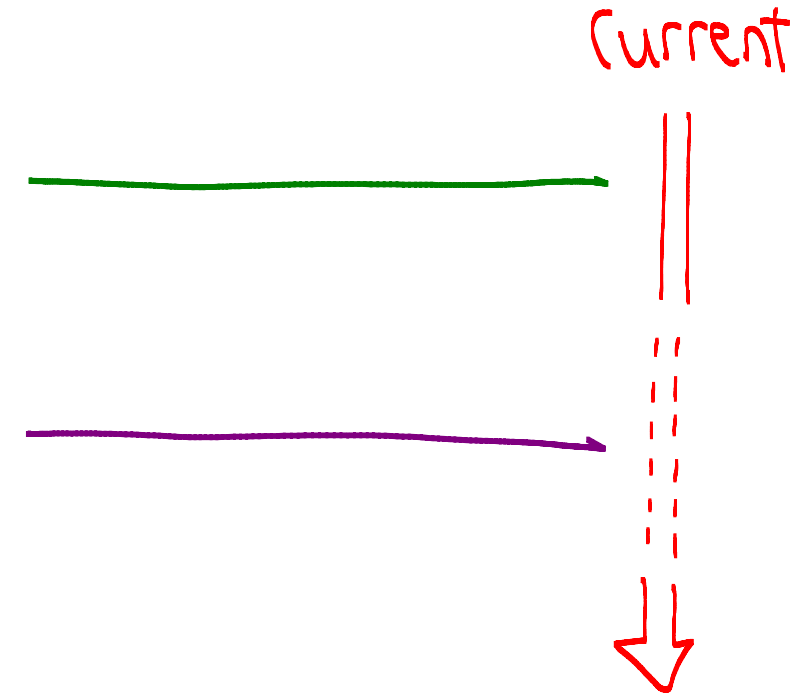


- Polarizable and Non-polarizable Electrodes

For Ag/AgCl electrode,

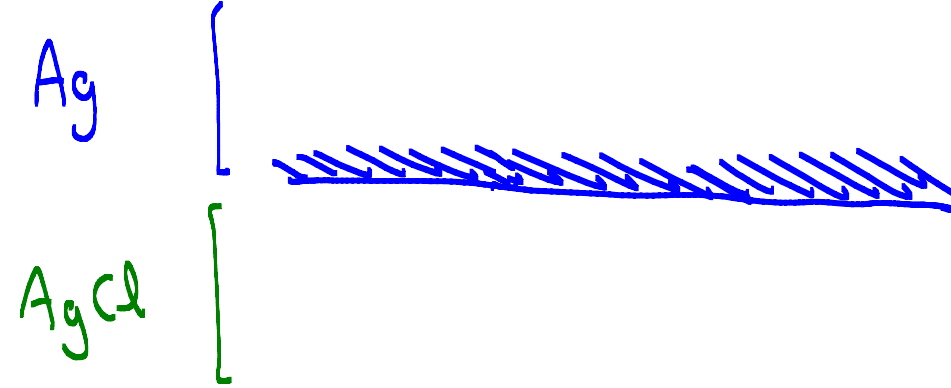


For gold electrode

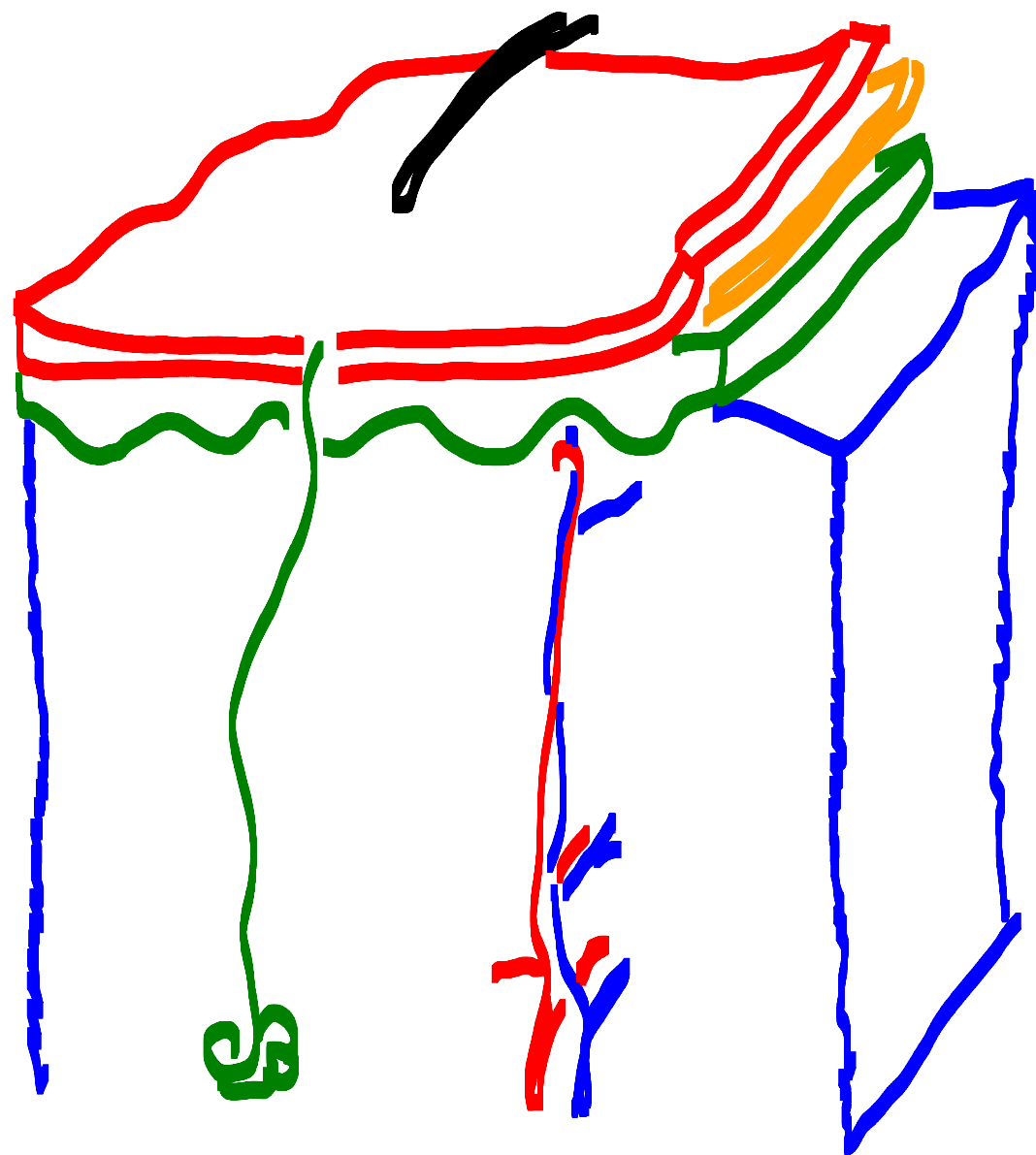


- Half-Cell Potential

Even when no current exists, there is a small voltage that develops across the electrode/electrolyte interface.



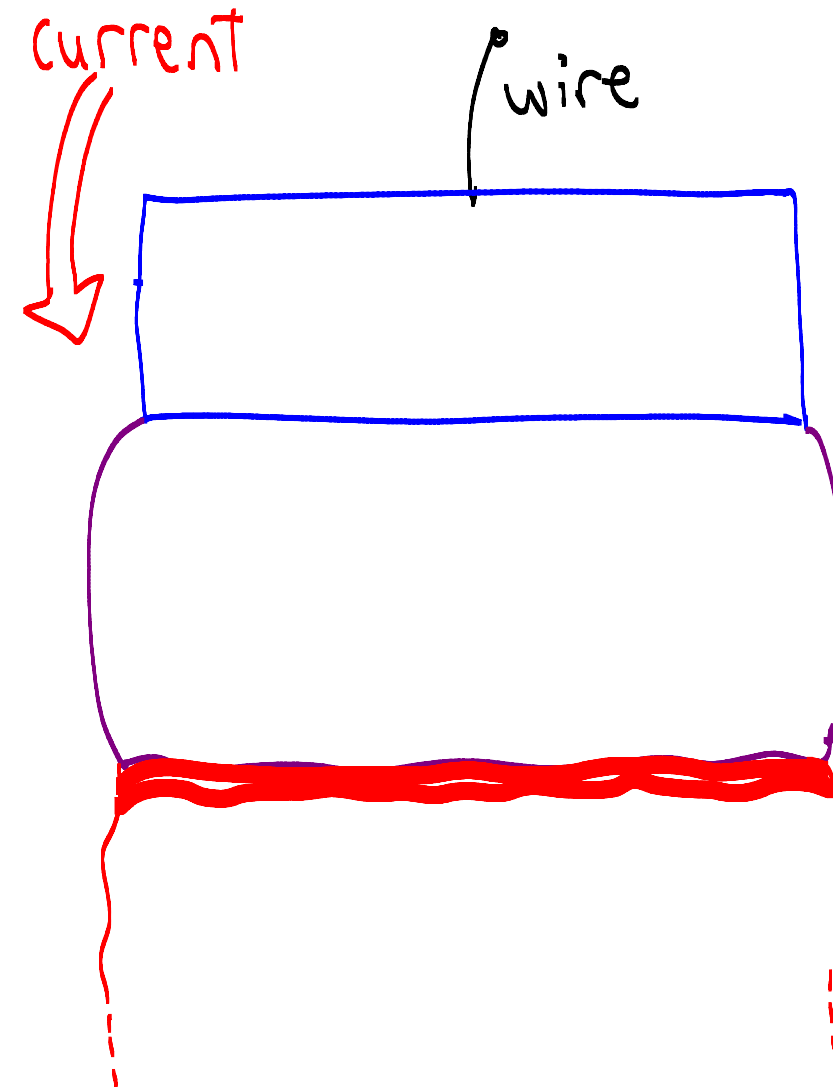
2. Electrode-Skin Interface



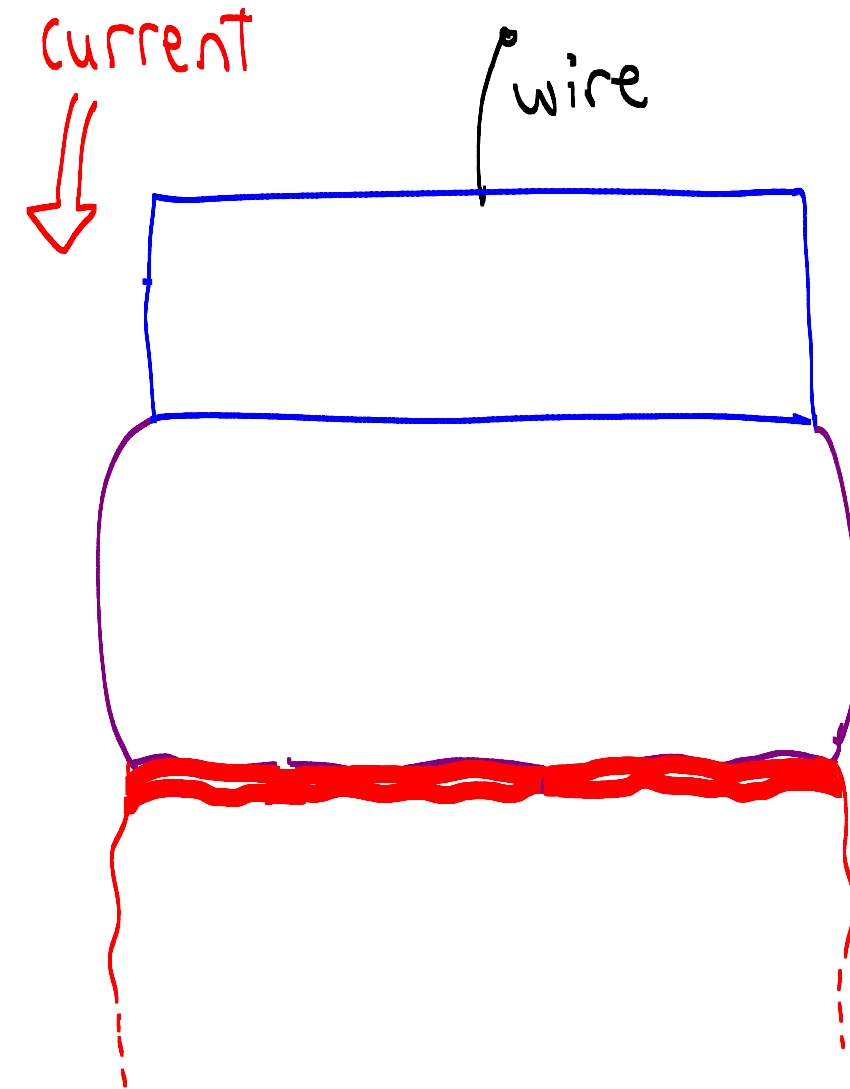
- Motion Artifacts ← Bad

Ag/AgCl Electrode

stratum corneum acts like a membrane
that is semipermeable to ions



- Polarizable electrodes (e.g. Au) also have a double layer of charge at electrode-electrolyte interface



3. Electromyography (EMG)

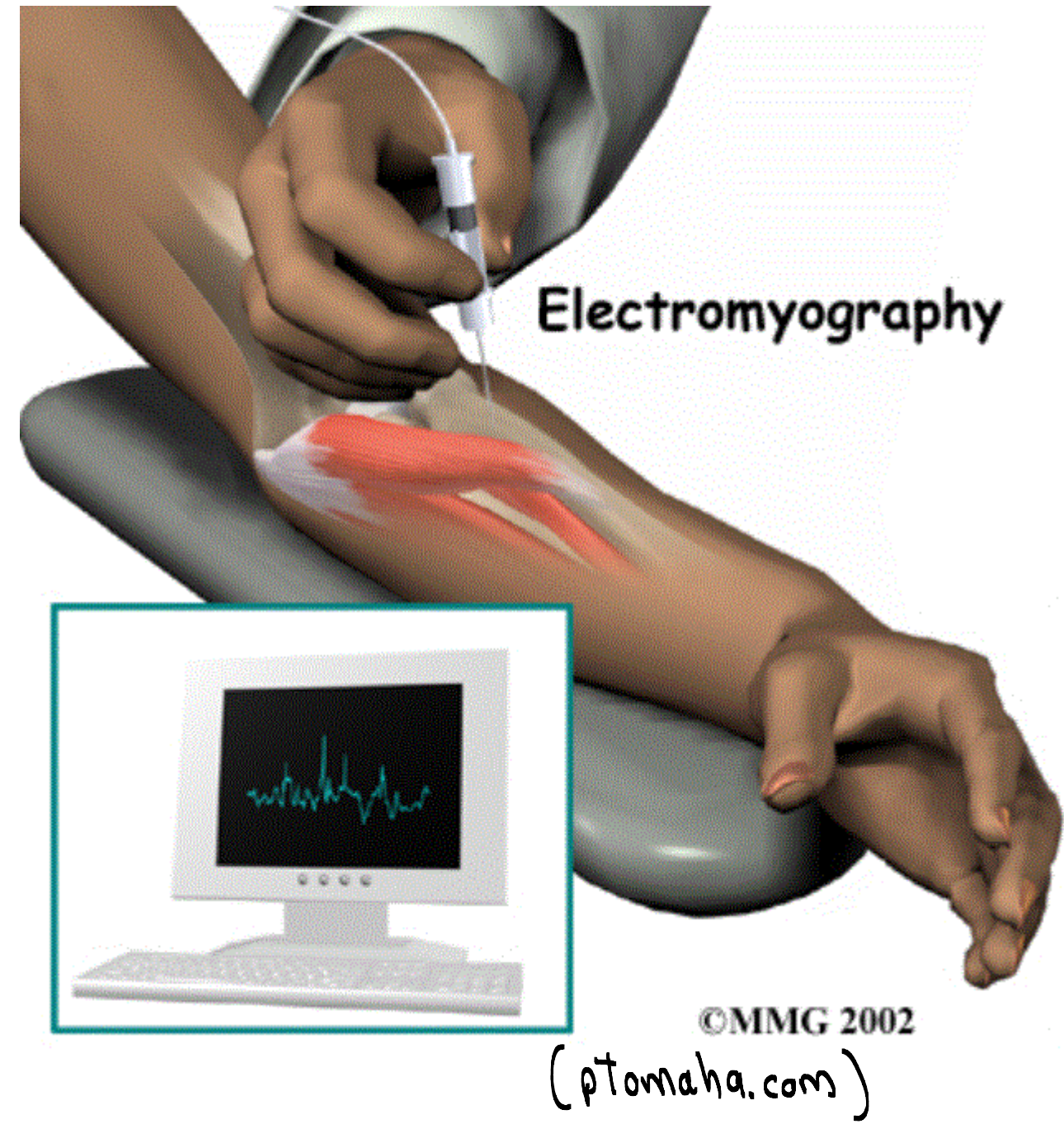
A. Intro

- Record the electrical activity associated with _____
- Diagnostic tool for identifying:

- Two electrode types:

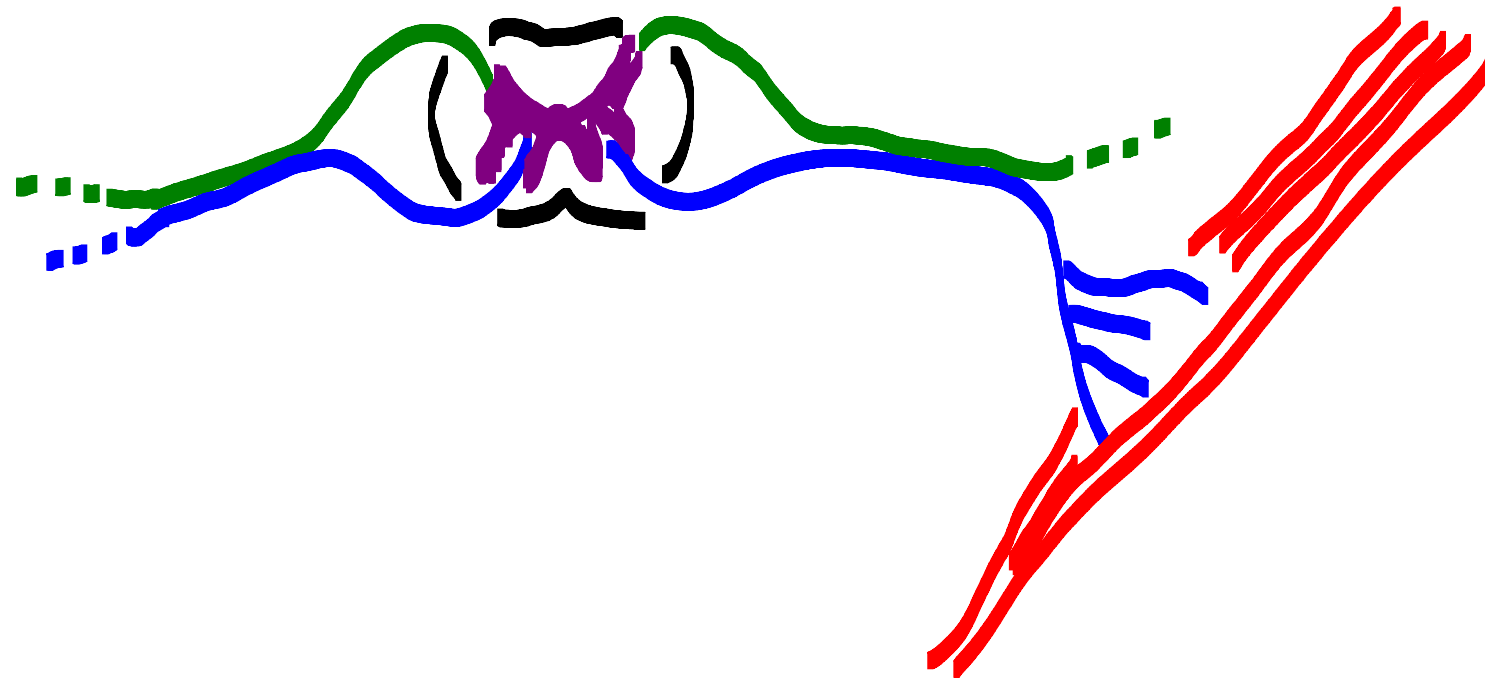
①

②



B. Single Motor Unit (SMU)

- Smallest neuromuscular unit that can be activated
- Muscle =
- Evoked field potential:



C. EMG Processing

→ Raw EMG signal is not that useful

Raw
EMG

